

Research Project Summary

Project Title

Comparison of the Different Planting Systems and Seeding Rates Effects on Quantity and Quality of Bread Wheat cultivar of Pishtaz and Selecting the most Economical System

Background and Objectives

Wheat is a staple crop central to food security in Iran and worldwide. To meet the increasing demand for both **higher yields** and **improved grain quality**, identifying optimal agronomic practices is essential. This project evaluated the performance of the advanced bread wheat cultivar **M-75-7** under different **planting systems** and **plant densities**, with the aim of:

1. Assessing their impact on **quantitative traits** (yield, biomass, yield components).
2. Measuring their influence on **qualitative traits** (grain protein content, baking quality, gluten characteristics).
3. Determining the **economic feasibility** of alternative planting practices to recommend the most profitable and sustainable system.

Methodology

- **Experimental Design:** A randomized complete block design with split plots in multiple replications.
- **Treatments:**
 - **Planting Systems:** Row planting, broadcasting, and mechanized sowing.
 - **Plant Densities:** Several seeding rates representing low, medium, and high plant densities.
- **Location:** Irrigated wheat production area with controlled field conditions.
- **Measurements:**
 - **Agronomic:** Plant height, spike number, grains per spike, 1,000-grain weight, biomass, grain yield.
 - **Quality:** Protein content, gluten strength, sedimentation value, bread-making quality.
 - **Economic:** Input costs (seed, irrigation, fertilizer, labor, machinery) vs. gross and net income.

Key Findings

Quantitative Performance

- **Grain Yield:** Planting system and density had significant effects on wheat productivity. The **row planting system with optimal density** consistently produced the **highest yields**.
- **Yield Components:** Medium plant densities achieved the best balance, producing more fertile tillers and heavier grain weight compared to very high or very low densities.

- **Biomass:** High-density planting increased biomass but did not necessarily translate to higher grain yield due to competition effects.

Qualitative Performance

- **Protein and Gluten Content:** Moderate plant densities improved **grain protein concentration** and **gluten strength**, which are critical for bread-making.
- **Baking Quality:** The row planting system produced flour with **superior baking quality** compared to broadcasting.
- **Sedimentation Value:** Higher under optimal densities, reflecting stronger gluten and better end-use quality.

Economic Analysis

- The **row planting system at optimal density** emerged as the most **cost-effective and profitable** combination.
- Although high-density planting increased certain costs (seed, irrigation), the yield gains did not offset the expenses.
- Broadcasting was the least efficient system, producing lower yields and quality with higher labor requirements.
- The **best treatment combination** delivered both the **highest net return** and **economic justification** for adoption by farmers.

Conclusions

- **Agonomic Recommendation:** The advanced bread wheat cultivar M-75-7 performs best under a **row planting system with medium plant density**, optimizing yield, quality, and profitability.
- **Scientific Contribution:** The project highlights the importance of balancing **plant density** and **planting method** to achieve both **high productivity** and **grain quality** in modern wheat systems.
- **Practical Implication:** Adoption of row planting with recommended density can significantly enhance farmer income, grain quality for baking industries, and long-term sustainability of irrigated wheat systems in Iran.

Broader Impact

- **Food Security:** Supports the dual goals of increasing wheat production and ensuring nutritional/baking quality.
- **Economic Sustainability:** Provides farmers with a scientifically validated method for maximizing profit.
- **Scalability:** Findings can be adapted to other wheat-growing regions with similar agro-ecological conditions, including areas in the U.S. and beyond.
- **Research Advancement:** Establishes a foundation for future studies on integrating **precision planting, conservation agriculture, and advanced breeding lines** for wheat improvement.